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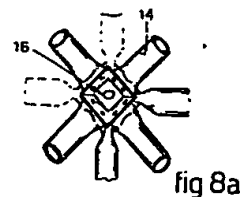
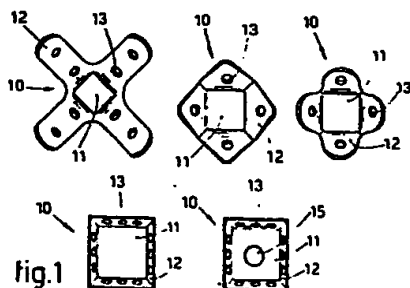
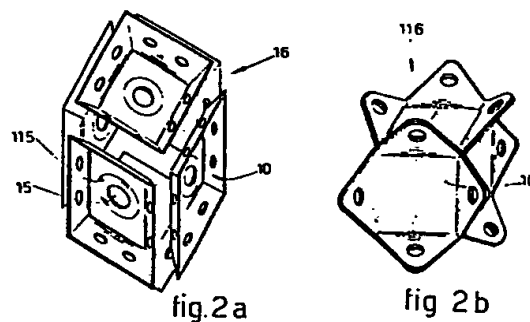
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(54) Connecting device for reticular spatial structures, and reticular structures employing such devices.

(57) This invention concerns a connecting device (10) for reticular spatial structures having nodal junctions to connect rods (14), said device being able to form said nodal junctions (16, 116) of said structures and comprising a middle area (11) of a substantially quadrangular shape, to which are connected four other perimetric areas (12) sloped at 45° to the plane on which said middle area (11) substantially lies, so that the assemblage of six of said devices (10) forms a nodal junction element (16, 116) having a geometric shape substantially comparable to a parallelepiped.

The invention also concerns reticular spatial structures comprising nodal junctions (16, 116) formed with the device of the claims hereinbefore.



E 04 B 1/17

1 Description of the invention entitled:

2 "CONNECTING DEVICE FOR RETICULAR SPATIAL STRUCTURES, AND

3 RETICULAR STRUCTURES EMPLOYING SUCH DEVICES"

4 in the name of Alfonso VOCCA at Eboli (SA).

5 -----  
6 This invention concerns a connecting device for reticular  
7 spatial structures and also concerns structures set up with  
8 said device.

9 To be more exact, this invention concerns a device able to  
10 form nodal junctions for connecting the rods in reticular  
11 spatial structures, which we shall also call grills or lat-  
12 tices hereinafter.

13 The invention also concerns grills of which the nodal  
14 junctions are obtained by fitting together the devices of the  
15 invention.

16 Reticular spatial systems have made considerable progress  
17 over the last ten years owing to the high technology employed  
18 in making the materials, to the highly precise processing  
19 methods and to the use of computers for the methods of cal-  
20 culation.

21 Connections, anchorages and supports for the remainder of  
22 the structure are covered in the acknowledged standards of  
23 engineering. All building materials used in resisting, en-  
24 closing and covering structures are adapted to said standards.

25 Spatial latticework and structures with a cubic mesh have a

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1 very great field of employment. A few examples thereof are  
2 flat roofing, or roofs of several pitches or in steps or of a  
3 pseudocupola type, etc. having small, medium and big spans for  
4 cantilever roofs, parking lots, sheds, service stations,  
5 motels, workshops, churches, swimming pools, gymnasias, bowls  
6 courts, bowling alleys, tennis courts, buildings for rest-  
7 aurants, shops, supermarkets, areas for shows, exhibitions and  
8 markets, cinemas, concert halls, conference halls, auditoria,  
9 grandstands, cycle tracks, sports stadia, aircraft hangers,  
10 shelters for playgrounds and pedestrian islands, open sheds  
11 for agriculture and livestock husbandry, large greenhouses,  
12 beams for big spans, large-scale antennas and towers, bridges  
13 and marine platforms, bearing structures for private and  
14 public buildings, bearing structures for skyscrapers, under-  
15 water structures, structures above ground to enclose dwelling  
16 spaces, macrostructures of plants for alternative sources of  
17 energy, radar and telescope equipment, latticework for tanks,  
18 equipment for airports, space travelling equipment, frames for  
19 satellites and space stations and so on.

20 In particular, cubic latticework finds an immediate ap-  
21 plication as a basic framework for structures resistant to  
22 earthquakes.

23 The reticular constructional systems at present on the  
24 market are relatively not very competitive with other building  
25 systems because either they (Mero type) have too high produc-  
26 tion costs owing to the extreme sophistication of processing  
27 and need skilled labour, or they (Unistrut type) are not very  
28 versatile as regards the use of types of grills or sections  
29 (only two-directional grills and U-shaped sections), or else  
30 they (Triodetic type) require special techniques and equipment  
31 for assembling the elements on the building site (pneumatic  
32 hammer for joining the ends of the rods to the nodal junct-  
33 ion).

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1 In any event a limit to the use of all the systems employed  
2 now lies in the inability to go below a given thickness and  
3 therefore below a given weight.

4 There does not exist at present on the market a cubic mesh  
5 system which is a natural support for industrialized building  
6 components. All efforts made in this field have always met  
7 with only partial success.

8 The modular nature of the system should ensure excellent  
9 integration of the building components and also permit stand-  
10 ardisation of computation of the structure, which, to be a  
11 cubic mesh, should comply with the laws and standards acquired  
12 to calculate its stresses without any need of a computer.

13 Standardisation of the lattice should also represent an  
14 improvement in the "response" of the structure to seismic  
15 stresses.

16 It is the purpose of our invention to provide a device  
17 which enables the foregoing shortcomings of reticular spatial  
18 structures to be avoided.

19 The device of the invention offers the following advantages  
20 in comparison to the prior art:-

- 21 1) ease of production with low costs;
- 22 2) ability to employ rods having any desired profile;
- 23 3) assembly and dismantling do not require skilled labour  
24 (pairs of workmen with at least two keys or at most an  
25 automatic wrench for bolts);
- 26 4) it enables roofing to be built up in steps or with a  
27 pseudocupola as well as flat or sloped roofing or roofing  
28 with one or more pitches, since it is possible to employ  
29 any thickness of grill, given an equal basic module;
- 30 5) it is extremely easy to transport;
- 31 6) small, medium and large thicknesses can be used for small,  
32 medium or large spans respectively; this leads to a con-  
33 siderable reduction in weight as compared to other retic-

*Gilberto Petraz*

1 ular systems;

2 7) it enables a covering roof to be built for any rectangular  
3 space by using latticework with a rectangular module of  
4 which the two sides are submultiples of the sides of the  
5 area to be covered;

6 8) cubic latticework, which is used advantageously for  
7 buildings that have to resist earthquakes, forms the most  
8 natural basic bearing structure in industrialized building  
9 work;

10 9) unlike all the other systems now in use, any damaging  
11 hyperstatic condition in the systems of our invention,  
12 whether in the spatial grills or in cubic lattices, is  
13 balanced and compensated by the fact that the nodal  
14 junction does not consist of one single piece but arises  
15 from the assembly of six devices; this enables the whole  
16 structure at all its nodal junctions to absorb stresses  
17 better and to respond better and evenly to variations in  
18 heat (expansion and contraction) and to stresses, even of  
19 a seismic nature;

20 10) the special method of attachment of the rods to the nodal  
21 junctions eliminates shear stresses which are present in  
22 other systems and which are due to compression and trac-  
23 tion at the ends of the rods;

24 11) costs for making the device are very low; setting-up on  
25 site is very easy; given an equal module, the weight per  
26 square metre is lower owing to the ability to choose the  
27 most suitable thickness. These advantages mean that the  
28 system is very competitive compared to all the other  
29 building systems.

30 The spatial aggregations which can be made by using the  
31 device of the invention are almost unending: cubic lattices,  
32 latticework in layers, flat grills with a triangular and  
33 quadrangular module, corrugated grills, grills with several

1 pitches and any slope, beams, latticework towers, cantilever  
2 structures, etc.

3 It is known that such reticular systems find an immediate  
4 practical application as bearing and covering structures.

5 In particular, the cubic lattice finds an immediate ap-  
6 plication as a basic framework for structures to resist  
7 earthquakes.

8 The device of the invention has a substantially quadr-  
9 angular shape with a substantially square middle area and with  
10 four other perimetric areas sloped at  $45^\circ$  to the plane of the  
11 middle area, said perimetric areas comprising holes for  
12 assembly by means of nuts and bolts or possibly rivets.

13 For the sake of simplicity we shall refer hereinafter,  
14 where not otherwise specified, to bolted connections.

15 The nodal junction is formed with six devices of the  
16 invention fitted together, which connect a maximum of twelve  
17 rods and provide spatial grills.

18 The nodal junction thus formed enables grills to be made  
19 with small, medium and large thicknesses for small, medium and  
20 large spans respectively.

21 When the device of the invention is butt-welded to any  
22 rolled or drawn section the axis of which is perpendicular to  
23 the middle area of the device itself, it gives rise to a  
24 lattice formed in three orthogonal directions, which is cubic  
25 if all the rods employed are of the same size.

26 For the sake of simplicity we shall refer hereinafter to a  
27 "cubic lattice", thereby also meaning the ability to obtain  
28 elongated parallelepipedal cells. For this latter particular  
29 lattice the device can also be made with a rectangular middle  
30 area.

31 In such a case the nodal junctions will have a prismatic  
32 shape with square bases if four of the devices are rectangular  
33 and two are square, or will have a parallelepipedal shape if

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1 the six devices fitted together to form the nodal junction are  
2 all rectangular and pairs of them are the same as each other.

3 The rods which can be used in conjunction with the device  
4 of the invention and with the nodal junctions formed with said  
5 device consist normally of a rolled or drawn rod having an  
6 opened or closed section and comprising blade-wise ends  
7 belonging to the same plane as that on which the axis of the  
8 rod lies.

9 One or more through holes made in the two ends enable the  
10 rod to be connected with elements which can be dismantled,  
11 such as bolts, or with fixed elements such as rivets, to the  
12 nodal junction formed with devices of the invention.

13 It is possible to employ rods of two different sizes to  
14 make grills, as will be described better hereinafter.

15 The blade-wise ends of a rod may perhaps not lie on the  
16 same plane as each other; this enables hyperbolic paraboloid  
17 grills to be made since in this way the orientation of the  
18 nodal junctions varies progressively along the structure.

19 The profile of the transition surface between the body and  
20 end of a rod may also be different from the profile of the  
21 corresponding edge of the perimetric area of the device to  
22 which the rod itself is connected.

23 In cubic lattice structures the rolled or drawn section is  
24 butt-welded to the device and therefore does not need blade-  
25 wise ends.

26 Rolled and drawn rods with an open section (I-sections, H-  
27 sections, etc.) are advantageously employed together with the  
28 device for this latter kind of structure.

29 The device of the invention can be made of pressed plate of  
30 a suitable thickness so as to obtain the shape and size wished  
31 or can be made by casting or die-casting.

32 Besides steels and light alloys, synthetic resins too can  
33 be considered, depending on the dimensional class to which the

1 product is manufactured.

2 A device suitable for forming cubic lattices can generally  
3 be made by casting as well as with plates welded together to  
4 constitute the device, which is then butt-welded to the rod.

5 A layer of sprayed asbestos cement can be envisaged to  
6 prevent fires and corrosion on reticular spatial steel struc-  
7 tures.

8 Otherwise, self-expanding varnishes can be used for fire-  
9 proofing, while varnishing and hot-dip galvanising can be  
10 employed for corrosion resistance.

11 Rods used in conjunction with the device of the invention  
12 can include suitable holes for the passage and/or anchorage of  
13 equipment.

14 The middle area of the device of the invention can be  
15 provided in its turn with one or more holes. Said holes can  
16 cooperate in the fixture of perpendicular rods to said area so  
17 as to obtain cubic lattices or can serve for the passage of  
18 equipment or for other purposes, as may be necessary.

19 According to the law of stability of structures ( $a=3n-6$ ,  
20 wherein  $a$ = the number of rods and  $n$ = the number of nodal  
21 junctions) the tetrahedron and octahedron are stable, and so  
22 those structures are stable which comprise tetrahedra and  
23 octahedra and which can be obtained by using nodal junctions  
24 formed with the device of the invention.

25 When a link undergoes tensions, through overloading for  
26 instance, the theory of strains shows that yielding should  
27 always take place at the same time through the whole system  
28 since the stresses in the grills are always distributed  
29 through the nodal junctions to all the rods, and the latter  
30 will undergo traction or compression, depending on the cir-  
31 cumstances.

32 Instead, yielding of the grill takes place, above all,  
33 following on concentrated loads (strain and localised break-



1 down of the material).

2 Strains should decrease progressively from the zone of  
3 concentrated load to the periphery.

4 Nodal junctions formed with the device of the invention are  
5 such that the rods in a grill under tension undergo torsion  
6 also at the same time as traction or compression. The blade-  
7 wise ends of the rods will then tend not to lie on the same  
8 plane as each other.

9 The torsion undergone by the rods is a wholly favourable  
10 fact since it opposes the forces of compression or traction,  
11 which are parallel to the surfaces gripped by the bolts and  
12 are in the direction of the rods, so that they tend to over-  
13 come the forces of friction in the links of the ends of the  
14 rods.

15 The perimetric areas of six devices fitted together to form  
16 a cube with "fins" at the edges or a pseudohypercube enhance  
17 the creation of this torsion (tending to deform a grill having  
18 a square module into a hyperbolic paraboloid) and thereby en-  
19 hance said forces of friction.

20 This invention is therefore embodied with a connecting  
21 device for reticular spatial structures having nodal junctions  
22 to connect rods, said device being able to form said nodal  
23 junctions of said structures and being characterized by  
24 comprising a middle area with a substantially quadrangular  
25 shape, to which four other perimetric areas are connected and  
26 sloped at  $45^\circ$  to the plane on which said middle area substan-  
27 tially lies, so that the assembly of six of said devices forms  
28 a nodal junction element having a geometric shape substant-  
29 ially comparable to a parallelepiped.

30 Moreover, the invention is embodied with reticular spatial  
31 structures or grills comprising nodal junctions formed with  
32 said device.

33 We shall describe hereinafter, as a non-restrictive

example, some preferential lay-outs and applications of the invention with the help of the attached tables, wherein:-

Figs.1 show some possible shapes of the device of the invention;

Figs.2 show assemblages of devices of the invention;

Figs.3 show details of tubular rods to be used in conjunction with devices of the invention;

Fig.4 shows a possible bolted connection of a rod to a nodal junction;

Fig.5 shows a tilted connection between a rod and a device;

Figs.6, 7 and 8 give various views of nodal junctions formed with the device of the invention and of the corresponding grills which can be obtained;

Figs.9,10 and 11 show grills which can be obtained according to the invention by using rods of two different sizes;

Figs.12 and 13 give examples of the formation of grills with a cubic mesh;

Fig.14 shows a tubular rod with ends which are not coplanar;

Fig.15 shows a hyperbolic paraboloid grill;

Fig.16 shows a build-up of tetrahedral and semi-octahedral meshes made by employing the device in question.

In the figures the same parts or parts having the same functions bear the same reference numbers.

Figs.1 show some shapes of the device of the invention. Said device 10 comprises a substantially quadrangular middle area 11, in relation to which four other perimetric areas 12 are sloped at 45°.

Each of the four perimetric areas 12 comprises one or more through holes 13, which have the same distances between their centres as those between the centres of the holes 113 in the

1 ends 114 of the rods 14 (see Fig.3a).

2 The middle area 11 of the device may comprise, or not, a  
3 central through hole 15, which may be surrounded, or not, by a  
4 strengthening ring 115 (Fig.2a).

5 The perimetric profile of the device 10 and the number and  
6 lay-out of the holes 13 in the perimetric areas 12 can vary  
7 and there will correspondingly be the same variations as  
8 regards the holes 113 in the ends 114 of the rods 14 as well.

9 Figs.2a and 2b respectively show two nodal junctions 16-116  
10 which can be obtained with two forms of the device of the  
11 invention. Said nodal junctions 16-116 have a shape substan-  
12 tially comparable to a cube.

13 When necessary or wanted, it is possible to assemble less  
14 than six devices 10 of the invention, thus obtaining nodal  
15 junctions 16-116 lacking one or more faces.

16 Fig.3a shows a detail of a blade-wise end 114 of a tubular  
17 rod 14. In this example said ends 114 are flattened so as to  
18 obtain the blade-wise profile desired. The holes 113 to secure  
19 the rod 14 can be clearly seen.

20 The rod 14 is shown in Fig.3b with its ends 114 coplanar in  
21 this instance.

22 One (or more) hole 17 is comprised near the end 114 of the  
23 rod 14 for the passage of galvanising metal inwards (Fig.3a).

24 The ends can be conformed also as in Fig.3c, thereby  
25 obviating the hole on the outer surface near the end 114. In  
26 this way the galvanising metal will enter through the holes 17  
27 made in the end itself.

28 Fig.4 shows diagrammatically a possible connection between  
29 devices 10 of a nodal junction 16 and a rod 14. In this  
30 instance said connection is made with bolts 22 but could be  
31 made with rivets, when so wished, or by welding.

32 In the case of one or more through holes 113 made in the  
33 ends 114 and when grills with rods of two different sizes are

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1 employed, the line between the centres of the holes will have  
2 a variation corresponding to the angle 18 (Fig.5).

3 The ends 114 of a rod may not lie on the same plane as each  
4 other (see Fig.14); this enables hyperbolic paraboloid grills  
5 19 to be constructed (see Fig.15).

6 Fig.6a shows a nodal junction 16 made with devices of the  
7 invention in a view which gives the spatial position of said  
8 nodal junction 16 as comprised in the spatial structure or  
9 grill 20 of Fig.6b, where a nodal junction 16 oriented and  
10 having its rods positioned as in Fig.6a is indicated with an  
11 arrow.

12 Fig.7a shows a nodal junction 16 according to the  
13 orientation of the nodal junction indicated with an arrow in  
14 Fig.7b. The tetrahedral arrangement which can be obtained by  
15 the invention for the grill 20 should be noted.

16 The plan of the grills 20 of Figs.6 and 7 comprises a tri-  
17 angular module 120.

18 The lay-out of Fig.8b shows, instead, a grill 21 with a  
19 quadrangular module 121. The relative orientation of the nodal  
20 junction 16 indicated with the arrow is shown in Fig.8a.

21 The figures make it clear how the two lay-outs arise from a  
22 different spatial orientation of the nodal junctions 16 in  
23 relation to the basic plane of the structure 20 or structure  
24 21 respectively.

25 If  $M$  = the size of the rod, we shall have  $H=M$ ,  $H=0.816 \times M$   
26 and  $H=0.707 \times M$  respectively in Figs.6b, 7b and 8b.

27 Figs.9 and 10 show the possibility of varying the height of  
28 grills formed according to the invention by employing rods of  
29 two different sizes. This is made possible because the axis of  
30 each rod 14 lies on a plane which contains the corner of the  
31 nodal junction-cube and internal diagonal and which can rotate  
32 around the axis of the anchorage bolt 22 perpendicular to said  
33 plane.

Therefore, in the grill with a triangular module diverse thicknesses H are determined with the same module 120 and can be used for diverse spans (Figs.9 and 10).

In any event, if the basic feature of the invention is preserved (the four perimetric areas 12 sloped at  $45^\circ$  to the middle area), the device 10 will have an edge such as to enable the rod to be secured in directions which are different but which always belong to a plane of rotation of which the axis is the assembly bolt 22.

In the grills 20-21 whereof the devices 10 have more than one through hole 13 in each perimetric area 12, the ends 114 of the rod will have corresponding through holes 113 with the direction of the line between centres of said holes suitably sloped (angle 18 of Fig.5) and depending on the ratio assumed in Fig.9 between the size M of the rod of the basic triangular module 20 and the size of the other three rods.

Thus a greater or lesser thickness H is also determined in the grill 21 with a quadrangular module 121, as shown in a side view in Fig.11b.

The grill with a square module will take up the form of a rectangular module (Figs.11a and 11c), of which the two sizes will be those derived from Fig.9, account being taken of the fact that the nature of the module 120 or 121 depends on the pre-selected orientation of the nodal junctions, or, in other words, on the fact that the basic plane of the grill contains a triangular module 120 or a quadrangular module 121.

It is therefore possible to see the noteworthy advantages which arise from the ability to choose, with this device, the thickness of grill most suitable for the design.

Assembly of the grill of the invention can be performed cantilever-wise by making use of a movable scaffold, or else, if space is available on the building site, it is possible to fit together whole grill elements on the ground and then hoist

1     them and put them in their final position by means of self-  
2     propelled cranes or other like lifting means. Said two  
3     procedures can be readily combined to suit the circumstances.

4     Fig.12 shows a possible connection between the ends of  
5     rods, which in this instance have an open profile 23 (I-  
6     sections, H-sections, etc.), and devices 10 forming a nodal  
7     junction 16. Said rods can also be of another type.

8     In the example shown the connection between rod 23 and  
9     device 10 is made by welding.

10     The assembly of six devices 10 (Fig.12) butt-welded to rods  
11     23 with an open profile determines a grill 24 according to  
12     three directions at right angles to each other, said grill  
13     being shown in Fig.13 with cubic latticework.

14     The sizes and dimensions of the rods 23, normally having an  
15     open profile, and of the nodal junctions 16 may vary in every  
16     way, depending on the design.

17     For cubic latticework the rod, normally having an open  
18     profile, can be pre-arranged, before being fitted, with a  
19     device 10 connected to each of its ends.

20     The rods 24 can be provided with holes 117 variously  
21     arranged for the passage and/or anchorage of elements of  
22     equipment on the structure.

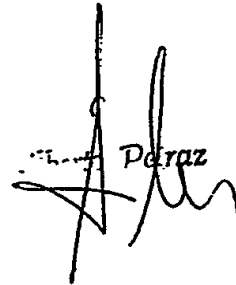
23     Fig.14 shows a rod 14 with blade-wise ends 114 which are  
24     not coplanar. In this way it is possible to form hyperbolic  
25     paraboloid grills 19 (Fig.15) wherein the orientation of the  
26     nodal junctions 16 varies continuously along the structure.

27     Fig.16 shows a build-up 25 of tetrahedra and semi-octahedra  
28     forming part of a grill 20-21 according to the invention. Said  
29     build-up 25 is seen in this instance as an octahedron-cube.

30     The quadrangular module 121, here square, is obtained with  
31     this build-up 25 by reference to a section plane parallel to  
32     one face of the cube 26 drawn with dashes in the figure, and  
33     the triangular module 120 is obtained by reference to a sect-

1 ion plane equally inclined in relation to three faces of the  
2 cube 26 with a common vertex 126.

3 The repetition in space of the octahedron-cube build-up 25  
4 shown in Fig.16 or of part thereof gives rise to reticular  
5 spatial structures which will have a triangular 120 or quadr-  
6 angular 121 module depending on the choice of the basic plane  
7 according to the aforesaid methods. — — — — —



J. Peraz

## INDEX

1	
2	10 - device
3	11 - middle area
4	12 - perimetric areas
5	13 - holes in perimetric areas
6	113 - holes in end of rod
7	14 - tubular rod
8	114 - blade-wise end
9	15 - central through hole
10	115 - strengthening ring
11	16 - nodal junction
12	116 - nodal junction
13	17 - hole
14	117 - hole
15	18 - angle
16	19 - hyperbolic paraboloid grill
17	20 - grill with triangular module
18	120 - triangular module
19	21 - grill with quadrangular module
20	121 - quadrangular module
21	22 - fixture bolt
22	23 - rod with open profile
23	24 - cubic latticework
24	25 - build-up
25	26 - cube
26	126 - vertex
27	M - size of rod
28	H - thickness of grill

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CLAIMS

- 1  
2 1 - Connecting device (10) for reticular spatial structures  
3 having nodal junctions to connect rods (14-23), said device  
4 being able to form said nodal junctions (16-116) of said  
5 structures and being characterized by comprising a middle area  
6 (11) of a substantially quadrangular shape, to which are con-  
7 nected four other perimetric areas (12) sloped at 45° to the  
8 plane on which said middle area (11) substantially lies, so  
9 that the assembly of six of said devices (10) forms a nodal  
10 junction element (16-116) having a geometric form substant-  
11 ially comparable to a parallelepiped (Figs.2).
- 12 2 - Connecting device (10) for reticular spatial structures as  
13 in Claim 1, characterized by the fact that the nodal junction  
14 element (16-116) has a geometric (cubic) shape with all six  
15 devices being the same.
- 16 3 - Connecting device (10) for reticular spatial structures as  
17 in Claim 1, characterized by the fact that the nodal junction  
18 element (16-116) has a geometric shape with at least four  
19 devices having a substantially rectangular form.
- 20 4 - Connecting device (10) for reticular spatial structures as  
21 in Claim 1 and in one or the other of the Claims thereafter,  
22 characterized by the fact that the perimetric areas (12) have  
23 a conformation (Figs.1 and 2) with fins.
- 24 5 - Connecting device (10) for reticular spatial structures as  
25 in Claim 1 and in one or another of the Claims thereafter,  
26 characterized by the fact that the middle area (11) comprises  
27 at least one through hole (15).
- 28 6 - Connecting device (10) for reticular spatial structures as  
29 in Claim 1 and in one or another of the Claims thereafter,  
30 characterized by the fact that each perimetric area (12)  
31 comprises at least one hole (13)
- 32 7 - Connecting device (10) for reticular spatial structures as  
33 in Claim 1 and in one or another of the Claims thereafter,

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characterized by consisting of any desired material.

8 - Reticular spatial structure, characterized by comprising nodal junctions (16-116) formed with the device of the Claims hereinbefore.

9 - Reticular spatial structure (20) as in Claim 8, characterized by comprising a triangular module (120) (Figs. 6b, 7b, 16).

10 - Reticular spatial structure (21) as in Claim 8, characterized by comprising a quadrangular module (121) (Fig. 8b).

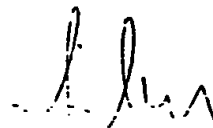
11 - Reticular spatial structure (20) as in Claim 8 and in Claim 9 or 10, characterized by comprising at least one nodal junction (16-116) assembled at least partially with rods (14-23) including blade-wise ends (114) that have at least one through hole (113) cooperating with at least one hole (13) comprised in each perimetric area (12).

12 - Reticular spatial structure (20) as in Claim 8 and in Claim 9 or 10, characterized by comprising at least one nodal junction (16-116) assembled at least partially with solidly fixed rods (23) (Fig. 12).

13 - Reticular spatial structure (20) as in Claim 8 and in one or another of the Claims thereafter, characterized by the fact that the rods (14 or 23) comprise at least one hole (17-117) near their end zone.

14 - Reticular spatial structure (20) as in Claim 8 and in one or another of the Claims thereafter, characterized by the fact that at least one nodal junction (16-116) cooperates with at least one rod (14) of which the blade-wise end (114) is connected to said nodal junction (16-116) and has a profile substantially the same as the profile of the corresponding perimetric area (12) of the device (10).

15 - Reticular spatial structure as in Claim 8 and in one or another of the Claims thereafter, characterized by the fact that the rods (14) cooperating with a nodal junction (16-116)



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1 have the same length as each other.

2 16 - Reticular spatial structure as in Claim 8 and in one or  
3 another of the Claims thereafter up to Claim 14 inclusive,  
4 characterized by the fact that the rods (14) cooperating with  
5 a nodal junction (16-116) have different lengths.

6 17 - Reticular spatial structure as in Claim 8, characterized  
7 by comprising a latticework extending in three orthogonal  
8 directions (Fig.13).

9 18 - Reticular spatial structure as in Claim 8 and in one or  
10 another of the Claims thereafter, characterized by comprising  
11 one or more pitches (Fig.15).

12 19 - Reticular spatial structure as in Claim 8 and in one or  
13 another of the Claims thereafter, characterized by the fact  
14 that at least part of the devices (10) forming a nodal  
15 junction (16-116) are connected with elements which can be  
16 dismantled (bolts, pins, etc.).

17 20 - Reticular spatial structure as in Claim 8 and in one or  
18 another of the Claims thereafter up to Claim 18 inclusive,  
19 characterized by the fact that at least part of the devices  
20 (10) forming the nodal junction (16-116) are connected in a  
21 fixed manner (riveting, welding, etc.).

  
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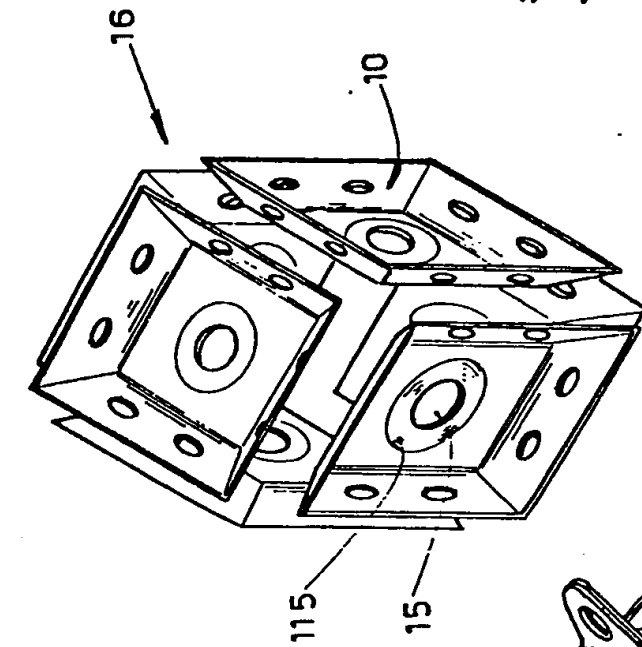


fig. 2 a

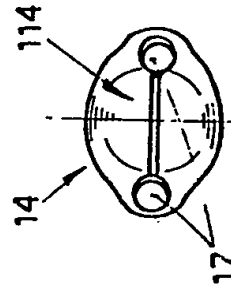


fig. 3 c

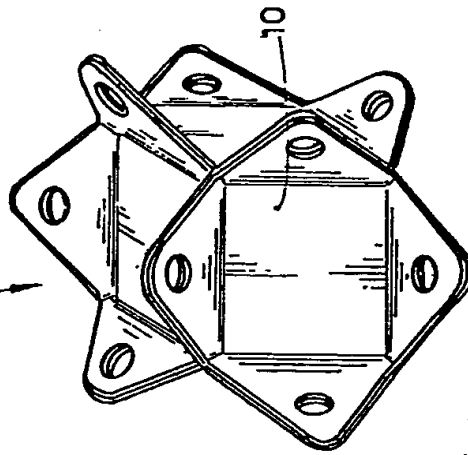


fig. 2 b

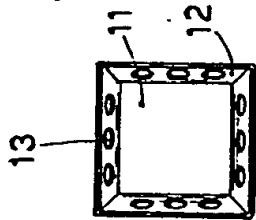
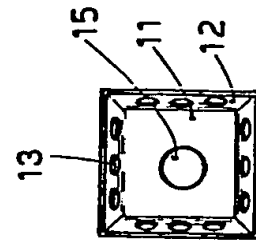
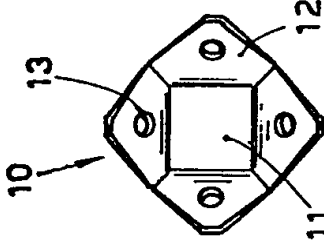
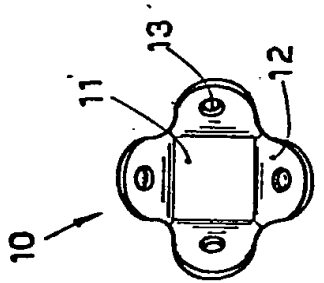


fig. 1

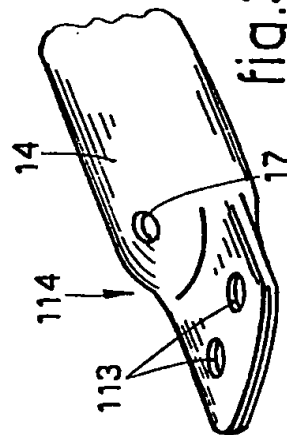


fig. 3 a

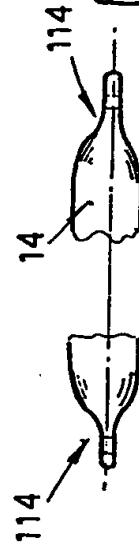


fig. 3 b

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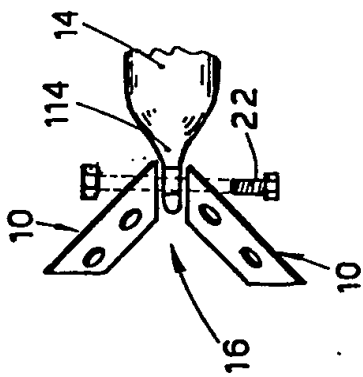


fig. 4

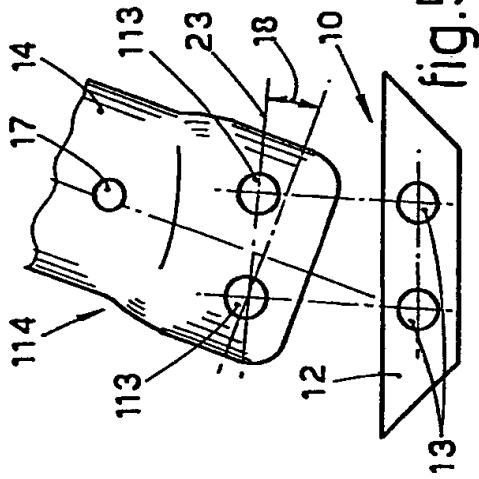


fig. 5

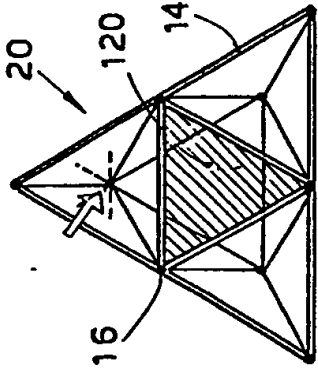


fig. 6a

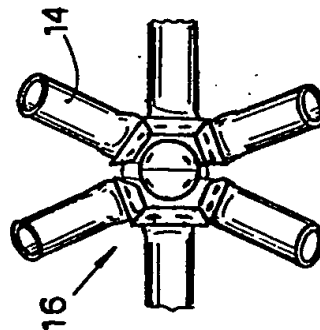


fig. 6b

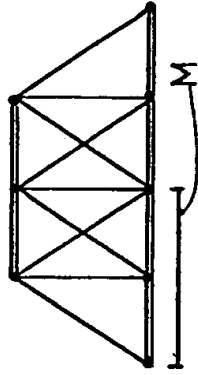


fig. 7a

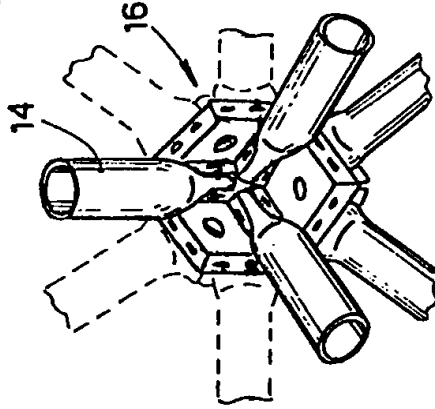
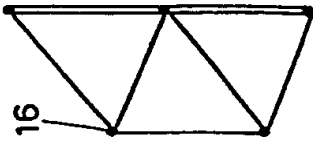


fig. 7b



*[Handwritten signature]*

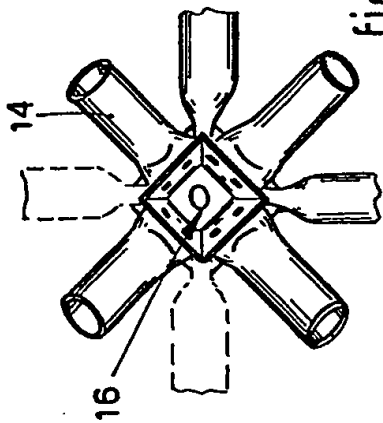


fig. 8a

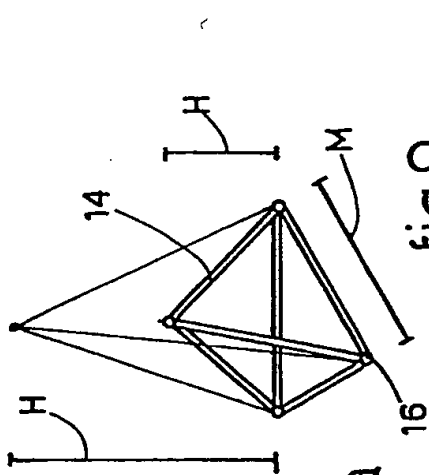


fig. 9

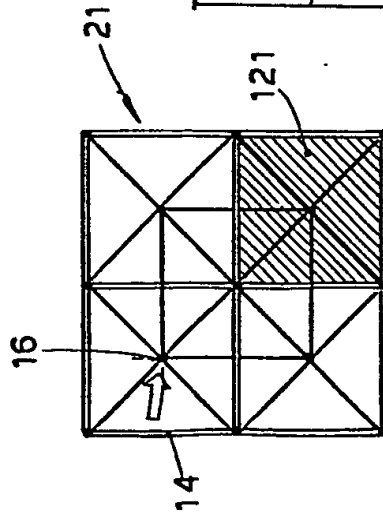


fig. 10

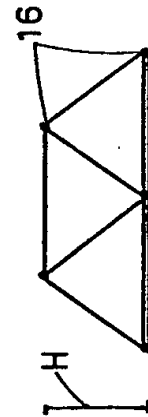


fig. 8b

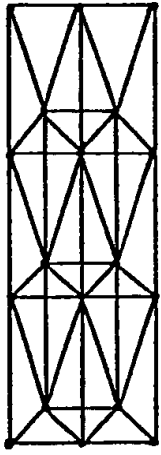


fig. 11a

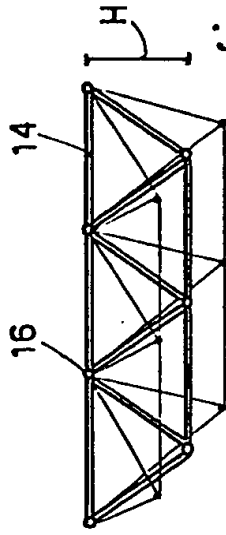


fig. 11b

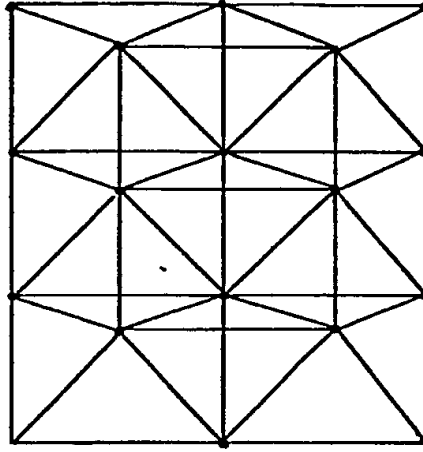


fig. 11c

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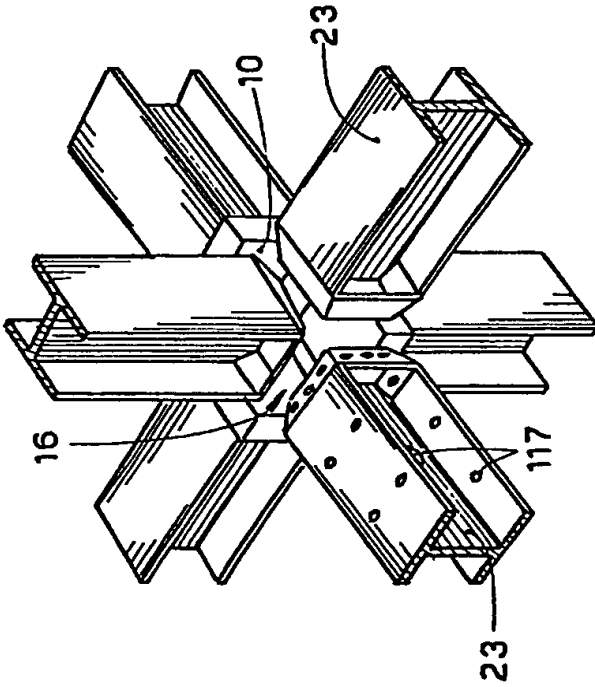


fig.12

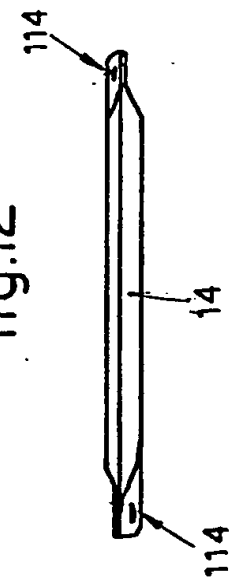


fig.14

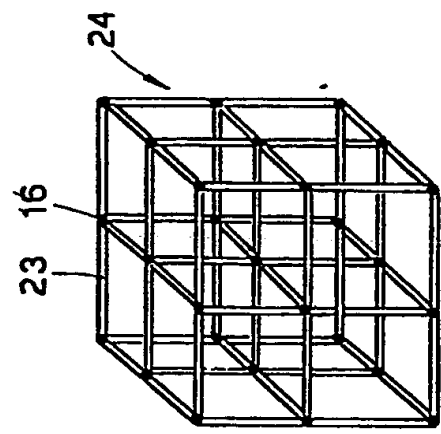


fig.13

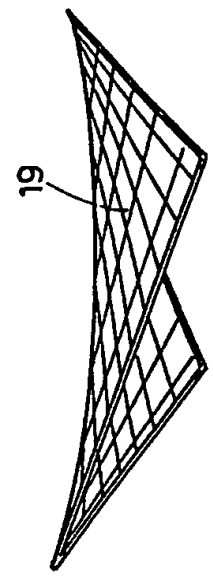


fig.15

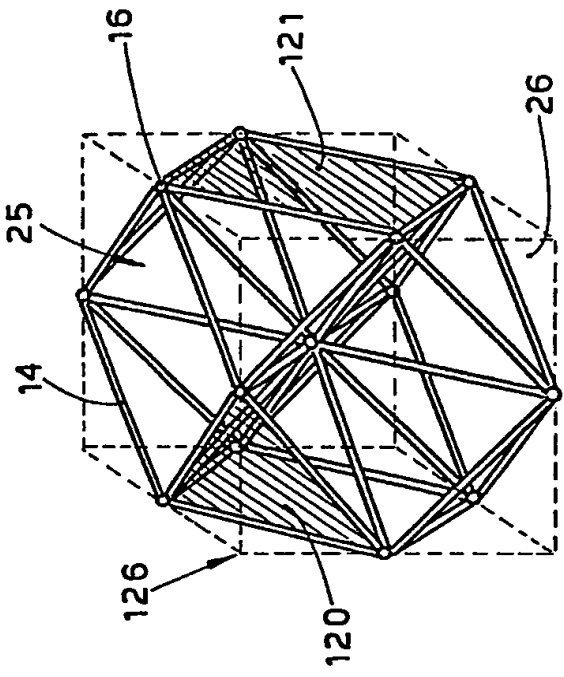


fig.16

Gilberto Petraz



European Patent  
Office

# EUROPEAN SEARCH REPORT

0079314

Application number

EP 82 83 0258

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
X	<p>--- US-A-3 563 580 (A.F. BLACK)</p> <p>* complete document *</p>	<p>1-3,6- 8,10, 11,14- 16,19</p>	<p>E 04 B 1/19 E 04 B 1/58</p>
X	<p>--- FR-A-2 386 714 (C. NASI)</p> <p>* claim 3; figures 7, 16 *</p>	<p>1-4,6, 8</p>	
A	<p>--- DE-B-2 116 707 (WURGAROHR GMBH)</p> <p>* complete document *</p>	<p>1-3,5, 7,8,12 ,17,19 ,20</p>	
A	<p>--- FR-A-1 280 634 (S. DU CHATEAU)</p> <p>* figures 1, 3, 4 *</p>	<p>9,10</p>	<p>TECHNICAL FIELDS SEARCHED (Int. Cl. 3)</p>
A	<p>--- GB-A-2 014 685 (J.-L. JEANNIN)</p> <p>* figure 1 *</p> <p>-----</p>	<p>6,11</p>	<p>E 04 B 1/00</p>
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 07-01-1983	Examiner KRABEL A.W.G.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons</p> <p>&amp; : member of the same patent family, corresponding document</p>			